Calcium and magnesium phosphate-based materials: interactions with Soft Matter and biomedical applications

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My research activity is mainly focused on the physico-chemical investigation of biologically-relevant calcium and magnesium phosphate-based nanostructures (CaPs and MgPs). These materials constitute the main inorganic components of human body, where they are present in several locations and fulfill a great number of functions (Figure 1) [1]. The study of their formation in bio-relevant conditions is thus noteworthy, as it could contribute both to unravel the *in vivo* formation mechanisms, as well as to guide the design of tailored materials for biomedical applications. Among the different scenarios in which amorphous and crystalline CaPs and MgPs are present in our organism, we mainly focused on synthetic analogs of amorphous magnesium-calcium phosphate nanoparticles (AMCPs) present in mammalians’ gut [2] and calciprotein particles (CPPs) which form upon the complexation of amorphous CaP and the protein Fetuin-A in human blood [3]. We studied their formation in conditions mimicking to a certain extent the in vivo milieu, with the ultimate goal of connecting the physico-chemical findings with the physiological and pathological role of these amorphous CaP-based nanostructures. For AMCPs, we inspected the effect of pH and Mg^{2+} on the lifetime of the amorphous phase, and we investigated how representative molecules belonging to Soft Matter present in the gut and in simulated intestinal fluids, as well as bio-relevant proteins, affect the formation and the features of AMCPs. For CPPs, their stability and crystallization processes at different Fetuin-A concentration and in the presence of stabilizers such as Mg^{2+}, citrate and pyrophosphate were inspected. As a general approach, these inorganic/hybrid nanostructures were prepared and characterized by means of a multi-technique approach including electron microscopy, X-rays diffraction, infrared spectroscopy, thermal analysis, light scattering and turbidimetry, which allowed us to obtain a complete physico-chemical overview of the systems.

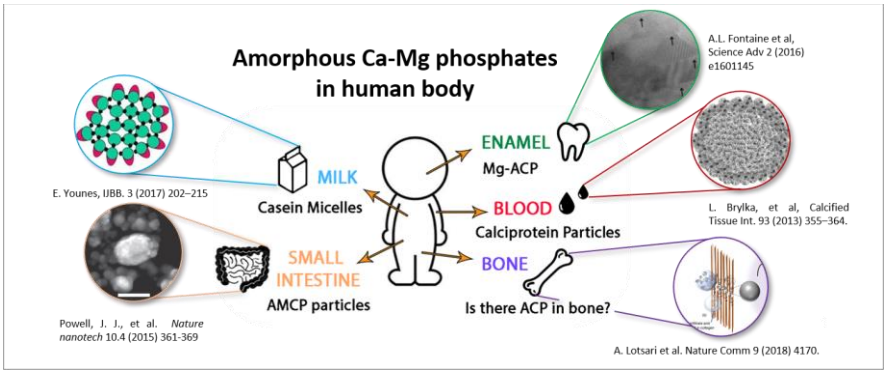

Figure 1. Sketch of the different scenarios where amorphous Ca and Mg phosphates are present in human body [1].

References

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